Review of Middle East Economics and Finance

Volume 7, *Number* 3 2011 *Article* 2

A Heckit Model of Sales Dynamics in Turkish Art Auctions: 2005-2008

Aylin Seçkin, *Istanbul Bilgi University*
Erdal Atukeren, *ETH Zurich, SBS Swiss Business School, BSL Business School Lausanne, University of Applied Sciences Northwestern Switzerland (FHNW)*

Recommended Citation:
Seçkin, Aylin and Atukeren, Erdal (2011) "A Heckit Model of Sales Dynamics in Turkish Art Auctions: 2005-2008," *Review of Middle East Economics and Finance*: Vol. 7: No. 3, Article 2.
DOI: 10.1515/1475-3693.1304

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Aylin Seçkin and Erdal Atukeren

Abstract

Unsold artworks are excluded from a traditional hedonic price index as no observable price can be attached to them. The question is whether the exclusion of unsold artworks lead to a sample selection bias in the traditionally constructed art price indices. In this paper, we examine the art auction sales performance in Turkey for the period between January 2005 and February 2008 using a unique database which contains 11,212 sales records including unsold items. We employ the two-stage Heckit model. Our empirical model combines demand-side influences with supply-side characteristics as well as the auction microstructure. We find that there is no sample selection bias created by unsold works. This finding also provides an explanation for why the attempts in the literature to identify which works are (not) sold turned out to be largely unsuccessful. On the behavioural side, we confirm the existence of the "afternoon effect" in both sales rates and in sales prices in Turkish art auctions. There is also some evidence for the "death effect" and "master effect" in both sales rates and sales prices. Finally, we find that the returns in the Turkish art market serve as a hedge against inflation in our sample period.

KEYWORDS: Turkish art market, sales probability in art auctions, hedonic prices, price anomalies

Author Notes: Corresponding author: Erdal Atukeren (atukeren@kof.ethz.ch and atukeren@alumni.uottawa.ca) The authors would like to thank Istanbul Bilgi University for the Research Grant No. 07-08/02. Earlier versions of this paper were presented at the ECOMOD 2009 Conference in Ottawa, Canada (June 2009), and at the Workshops at the Economics Departments of the University of Ottawa and Carleton University (May 2009). We would like to thank the participants of the sessions and the workshops for their valuable comments. We are also grateful to two anonymous referees for their suggestions that led to many improvements. The usual disclaimer applies.

1. Introduction

What determines the successful sale of an individual item in an art auction is no easy task to address. The attempts in the literature in this respect focus on the role of the pre-auction price range estimates, auction house strategy, and the hedonic characteristics of the artwork and the artist. Nevertheless, these attempts have been largely unsuccessful. The successful explanation of the determinants of sales success of artworks is important not only for a better understanding of the inner workings of art auctions, but it also has implications for the unbiased construction of art market price indices in the statistical sense.

In this paper, we examine the art auction market performance in Turkey for the January 2005 - February 2008 period using a unique database containing 11,212 auction records. The sample includes 6,771 sold artworks. The problem with many art market price indices in the literature is that they discard unsold artworks since an observed sale price cannot be attached to them. However, this practice may lead to biased estimates if the unsold and sold paintings are not independently distributed. Our study addresses this problem by employing the Tobit II sample selection (Heckit) model developed by Heckman (1979) where unsold works are treated as unobserved (trunctated) values. The application of the Heckit model to auction data is still a largely unexplored research area in the economics of art markets.[1]

Furthermore, our study includes business survey and consumer confidence variables on macroeconomic developments and expectations in addition to the hedonic characteristics of auctioned items and the variables capturing the auctions' micro-structure. We also test for the presence of various art market anomalies, such as the "afternoon effect", the "death effect", and the "master / reputation effect" in both sales rates and sales prices.

The rest of the paper is organized as follows: The potential sample selection problem and the determinants of sales prices and sales probability of artworks are presented in Section 2. Section 3 discusses the Turkish art market and the data used in our study. We present an overview of the Heckit two-stage sample selection model in Section 4 and discuss the issues in model construction and the explanatory variables. Section 5 presents the estimation results for the modified hedonic and the sample selection equations of the Heckit model. Section 6 compares the results from a conventional hedonic price model that ignores unsold paintings with those obtained from the Heckit model in terms of their implications for financial returns in the Turkish art market. Section 7 concludes the paper.

[1] See Collins et al. (2009).

2. Recent Literature Review on Art Auctions

2.a A Bias due to Unsold Works?

When estimating a traditional hedonic or repeat-sales price index, only the sold items are included. There might be a reservation selling price for the unsold works, but since this price is unobserved, a price cannot be attached to unsold items in the traditional hedonic (and repeat-sales) price indices. The dimension of the problem is large since the long term average of unsold (or "bought-in") works in international art auctions is about 30-35 percent (Artprice, 2010). Whether or not the omission of unsold works from the traditionally constructed indices creates a sample selection bias, however, depends on the data generating processes for the "unsold" and "sold" objects. If they come from independent probability distributions, then omitting the unsold works lead to biased results.

The question of unsold artworks in auctions was noted by Goetzman (1996), Goetzmann and Peng (2006), Marinelli and Palomba (2008) and Collins et al. (2009). Goetzmann and Peng (2006) argue that in the presence of seller reservation prices, transaction prices may provide misleading information regarding the demand and supply in markets. They relate the problem to the sample selection bias and the probability of unsold items in an auction. Marinelli and Palomba (2008) use Heckman's two-step approach and find that the presale evaluations by experts turn out to be a key driver of the sales probability as well as the auction price levels. However, they take this finding with scepticism as its sufficiency is rejected and some interpretation problems remain. Collins et al. (2009) also find evidence for the sample selection bias for a sample of art works on 1915 symbolist paintings which went to international auctions during the period 1990-2001. Collins et al. (2009) illustrate that art price indices obtained under a traditional hedonic model and under a Heckit model show differences due to the exclusion of unsold items from the traditional hedonic models.

The recent evidence focusing on the broader implications of unsold works in art auctions brings one's attention to the determinants of the successful sale of an art object in an auction. The Heckit model employed by Collins et al. (2009), for instance, requires the specification for the selection equations where the factors affecting the sales probability of an artwork is specified. In what follows, we review the literature on the price determinants, sales dynamics and the behavioral aspects (including price anomalies) at work in art auctions.

2.b Empirical Evidence on Sales Dynamics of Art Auctions

Given the importance of the distributional relationship between the sold and unsold artworks in auctions for the validity of art price indices, it is essential to

identify the factors that affect probability of sales success and (if sold) the level of sales prices for an artwork in an auction.

There are various lines of studies in the literature on art auction markets that focus on single or multiple factors that examine the factors which influence the sales probability, or more generally, the sales price of an artwork.[2] They can be grouped under the following general themes: 1) Masterpiece effects, 2) Death effects, 3) Effects of sales order in auctions (declining price anomaly or the afternoon effect), 4) Experts' pre-sales price estimates, 5) The so-called "burnt" or "bought-in" painting effect, 6) Auction house (strategy) effects, and 7) The hedonic characteristics of individual artworks, the artists, and the auction houses.

The widespread notion that the best or more expensive artworks tend to generate above average returns is defined as the masterpiece effect. However, there is no consensus on its evidence. Pesando and Shum (2008) find mixed support for the masterpiece effect in the market for prints for the period 1977-2004. Mei and Moses (2002), on the other hand, find a negative masterpiece effect due to overbidding and mean reversion. Goetzmann (1996) explains this effect with the survivorship bias.[3] Ginsburgh and Jeanfils (1995) and Campos and Barbosa (2009) also find no masterpiece effect.

In analysing the death effect, Ekelund, Ressler and Watson (2000) focus on a possible supply-induced demand-side factor. By making an analogy between a durable goods monopolist and an artist, they explain the rise in prices following the death of an artist as the expectations on the part of the art buyers concerning the future supply of the artists' works.

Ashenfelter (1989) and Ginsburgh (1998) show the presence of a declining price anomaly in wine auctions and related it to a fatigue effect, i.e., people get tired as the auction proceeds and prices decline. Pesando and Shum (1996), and Beggs and Graddy (1997) study this effect on art auctions.[4]

Beggs and Graddy (1997) study also the order of sales in art auctions. In a theoretical model of an auction with declining valuation, they show that, even in the presence of risk-neutral strategic bidders, the bid price to the estimate ratio

[2] The literature on various micro aspects of art auctions and the financial returns to art investments are surveyed by Ashenfelter and Graddy (2003).

[3] The masterpiece effect is about the fact that the more expensive paintings remain in the sample throughout, even if they decreased in value, whereas less-expensive paintings drop out of the sample. However, as Pesando and Shum (2008) argue there should not be masterpiece effect in risk-adjusted terms if the art market is efficient.

[4] In a sequential auction of commercial properties, Lusht (1994) finds that prices decline as the auction proceeds given that the bidders are either risk-averse or quantity-constrained. Picci and Scorcu (2003) do not find any afternoon effect once they employ a dynamic model allowing for affiliation, information, or other psychological effects.

declines. They also find that ordering heterogenous items by value maximises revenue for the auctioneer.[5]

Deltas and Kosmopoulou (2004) examine bidding in a rare book sequential auction with alphabetically ordered lots where absentee bidders placed half of the bids. They disentangle the catalogue effects from those of the sequential nature of the sale. They relate catalogue effects to the reduction in the attention span of bidders. Towards the end of the catalogue, the attention reduction leads them to focus on lots with long descriptions and ignore the lots with smaller descriptions. They show that the catalogue effects can also influence floor bidder behavior.

Numerous papers addressed the role of auctioneer pre-sale price estimates. There are several questions on this topic, such as: Are the estimates biased? If so, do the experts commit systematical errors because they are not efficient? Are the biases stable over time? What motivates auctioneers to assign a price spread? For instance, a wide estimate window may signal a high estimate of price variance and uncertainty and give an indication about the reservation price.[6]

Ashenfelter, Graddy and Stevens (2003) address the question of why the sales rates differ so dramatically over time and across sections by examining the determinants of a seller's reserve price in a model of sequential search borrowed from the empirical search models. They show a strong relationship between sales rates and price shocks, as measured by the difference between realised prices and auctioneers' estimates.[7] Using a repeat-sales method on impressionist and modern art, Beggs and Graddy (2006) identify and estimate lower returns for items that fail at auction. They argue that lower returns are due to common value effects, changes in the seller's reserve price, or idiosyncratic downward trends in taste. They also find that a smaller spread being positively correlated with the probability of unsold items.[8]

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[5] Risk-aversion is yet another reason for declining prices according to McAfee and Vincent (1993).

[6] According to Louargand and McDaniel (1991), the efficiency of art market also can be checked by examining the experts' estimates.

[7] Under plausible assumptions, they find that the optimal policy is to set a reserve price that is a constant proportion of the current expected price. Furthermore, this constant proportion depends only on the variances of the log prices and the seller's discount rate. They estimate that the reserve price in art auctions is set to be between 70 and 80 per cent of the lower estimate of the item.

[8] Bauwens and Ginsburgh (2000) find that Sotheby's systematically underestimates the expensive objects. They test explicitly for the efficiency of the auctioneers' estimates. They find that experts do not seem to take advantage of all the information that is contained in the sales catalogues. Ashenfelter (1989) finds that high and low estimates are highly correlated with the actual prices. Abowd and Ashenfelter (1988) show that auctioneers' price estimates are far better predictors of prices fetched than hedonic price functions. Chanel et al. (1996) argue that experts provide more systematic estimates using all available information on the characteristics of the paintings. D'Souza and Prentice (2002) test whether the variance from the regression on actual prices is significantly better than the one with the midpoint price estimate of the experts. If it is so, then the

Another possibility is that auctioneers may manipulate prices for strategic purposes. Mei and Moses (2005) examine the relationship between auctioneer presale price estimates and the long-term performance of artworks. They find that the price estimates for expensive paintings are systematically overestimated over more than 30 years. High estimates are associated with subsequently lower returns. Furthermore, they show that the estimation errors are quite small but the bias could be very large for high-price items. Their results support the strategic behavior of auction houses in price manipulation. They also argue that some investors are credulous.

Marinelli and Palomba (2008) and Campos and Barbosa (2009) recently attempt at explaining the sales probability of a painting. Marinelli and Palomba (2008) introduce experts' price estimates in a probit model to explain the sales probability and the actual price of an item. They find that high price estimates decrease the sales probability while increasing the actual price.[9] Campos and Barbosa (2009) estimate the sales probability and find that the estimate window (price range or spread) is negatively and significantly related to the likelihood of a "no sale" at auctions.

3. The Turkish Art Market

The Turkish art auction market is rather young but a rapidly developing dynamic market. Seçkin and Atukeren (2006, 2009) provide an overview of the Turkish art market and its financial dynamics as an investment opportunity. The Turkish art scene gained momentum especially in the recent years with the entry of few new private art museums such as, Sabancı Museum, Istanbul Modern, Pera Museum, and Santral Istanbul. A number of headline events also fuelled the media and public interest in the art market. For instance, a painting titled "The Turtle Trainer" by Osman Hamdi Bey (1842-1910) was sold for 3.5 million US dollars in November 2004. Another work by Osman Hamdi Bey titled "A Lady of Istanbul" was sold for 3.4 million pounds in May 2008 in a Sotheby's auction held in London. Furthermore, in March 2009, the first Turkish Contemporary Art Auction was organized for 71 works at Sotheby's London. In November 2009, Burhan Doğançay's painting titled "The Blue Symphony" was sold for 2.2 million Turkish lira (about USD 1.5 million) in an auction in Turkey.

There are no reliable estimates of the size of the art market in Turkey. Based only on auction data, the size of the art market is estimated to be about

auctioneer appears to estimate prices more systematically. However, the market yields more systematic estimates if the regression on actual prices is significantly less predictive.

[9] They find that the name of the artist and his/her living status are relevant but some correction of sample selection bias is needed. Their results imply that auction house prestige and the year of sale are more important than the physical aspects of the paintings.

US$ 10 million in 2000. The Turkish economy suffered a severe banking crisis in 2001 and the art auction sales proceeds fell to US$ 4.8 million. From 2002 on, a rapid increase in the size of the Turkish art auction market was observed. For instance, the size of the market reached nearly US$ 20 million in 2005 and US$ 51 million in 2007. The global financial crisis also affected the Turkish economy and global art auction markets. The decline in the auction sales revenues in the Turksih art scene was still relatively moderate, with a decline in the art auction sales to US$ 45 million in 2008. More recently, in tandem with the global art markets, the Turkish art recovered and the sales amounts reached nearly to US$ 90 million in 2010.[10]

Given the connection between art markets and the economy, the recent developments in the Turkish art market should also be examined in view of macroeconomic dynamics. Traditionally, the Turkish economy suffered from many years of high inflation. The average consumer price inflation rate during 1990 – 2002 was about 70 per cent. Following the economic crisis in 2001, Turkey experienced high real GDP growth rates and a period of economic stabilisation. The annual real GDP growth rates in 2005, 2006, and 2007 were 8.4 per cent, 6.9 per cent, and 4.5 per cent, respectively. Turkey also made a currency reform at the beginning 2005 and dropped six zeros from its currency. The exchange rate regime which led to the real appreciation of the Turkish lira after the currency reform at the beginning of 2005 has been a major policy anchor in achieving macroeconomic stabilisation. During 2005-2008, inflation rates also came down substantially. The year-end consumer price inflation rates were 7.7 per cent in 2005, 9.7 per cent in 2006, 8.4 per cent in 2007, and 10.1 per cent in 2008. Given the vivid developments in the Turkish art market along with the improvements in macroeconomic conditions, the period after the 2001 crisis provides a fertile ground studying the dynamics of the domestic art auction market in Turkey.

In this study, we focus on the post-currency reform era. We use a unique database that covers the period from January 2005 to February 2008 with a total of 11,212 individual auction records – including unsold items.[11] The dataset was obtained from www.lebriz.com by subscription, screened for incomplete records, and processed manually into a database. The auction records include the characteristics of the artworks that are brought to an auction for sale, the opening price, and the result of the auction, i.e. whether the item is sold or not and the sales price if sold. It should be noted that the overall sales rate is about 60.4 per

[10] The annual art auction sales figures are based on the information obtained from www.lebriz.com.
[11] The actual number of auctioned works in this period is 12,974. Nevertheless, 1762 records contained incomple or unusable information and could not be included in the sample, leaving us with 11,212 complete records.

cent for the auctions in our sample. There is, however, a large variation. The sales rates range from about one-third to around 90 per cent in individual auctions.

4. A Heckit Model of the Determinants of Sales Probability of Artworks

4.1 Heckit Model

Earlier price indices for the Turkish art market were calculated by Seçkin and Atukeren (2006, 2009) – albeit only for paintings for the 1990–2005 period. Those indices included the prices of the actually sold items in the auctions. A novelty in our analysis is to make use of a full sample of sold and unsold artworks. We approach the problem of unsold artworks as censored observations and employ the Heckman's (1979) Tobit II sample selection model. Using this framework, we are able to test for the independence of the distributions of the unsold and sold paintings and construct a final price index that includes both sold and unsold paintings. Furthermore, we compare the outcome from this model with the conventional approach that ignores the unsold works.

The Heckit procedure uses two estimation steps. The sample consists of N observations. However, the variable of interest, the sold paintings, is observed only for n < N. The first stage involves the estimation of a probit model to explain what leads to a successful outcome (i.e., an item is "sold" in our case). In general, this selection equation is expressed in terms of a latent variable z_i^* that depends on one or more explanatory variables w_i' and is given by:

$$z_i^* = w_i' \gamma + u_i \qquad i = 1,...N \tag{1}$$

where N is the sample size, z_i^* is the latent variable, w_i' is the *1xK* vector determinants of whether the painting is sold or not, γ is a *K*-dimensional vector of unknown parameters, and u_i is a well-behaved random disturbance term.

Note that we observe the binary outcome (z_i) which takes the value of "1" when an artwork is sold and "0" otherwise instead of the the latent variable z_i^*, which is not observable. In our context, the estimation results from this stage of the Heckit model can also be interpreted as the determinants of the sales success of individual artworks.

The second stage of the Heckit model involves the estimation of a modified hedonic model in which y_i, the log price of the artworks in our model, is the dependent variable. The modified or the augmented model is based on the following conditional regression function:

$$E(y_i \left| z_i^* > 0) = x_i' \beta + \delta \lambda_i \quad i = 1,...,n \right. \tag{2}$$

where $x_i^{'}$ is the *1xM* vector containing the individual characteristics of a painting, the painters and the auction houses, and any other relevant information (such as, macroeconomic variables and expectations) β is an *M*-dimensional vector of unknown parameters and ε_i is a well-behaved random disturbance term. The additional variable in the model, λ_i, is the Inverse Mill's Ratio, *IMR*, (cf. Verbeek, 2008: 241, equation 7.84), which is equal to:

$$\lambda_i = \frac{\phi(w_i^{'}\gamma)}{\Phi(w_i^{'}\gamma)}$$

where $\phi(.)$ denotes the standard normal probability density function and $\Phi(.)$ denotes the cumulative distribution function for a standard normal random variable. While λ_i is not known, we can estimate the parameters vector γ using the probit model in the first stage, obtain $\widetilde{\lambda}_i$, and then estimate equation (2).

Whether the IMR variable turns out to be statistically significant or not is a critical point since the consistent estimation of a model that does not include the unsold artworks requires the δ parameter to be statistically not different than zero. Otherwise, a sample selection bias arises as we would be choosing only the successful sales outcomes while there is no statistical basis to exclude the non-successful outcomes. In other words, the IMR variable created from the first-step probit estimation serves as the basis for testing whether the sold and unsold artworks come from independent random samples or not. This analysis has important implications for the statistical validity of the art market price indices that include only the sold items.

4.2. Explanatory Variables

The variables included in our analysis in both stages of the Heckit model can be broadly categorised as follows: 1) Auction houses and the seasonal factors; 2) Hedonic characteristics of the artwork 3) Hedonic characteristics of the artist; 4) Microstructure of the auction; 5) Business and consumer confidence indicators based on survey data to capture the anticipations on macroeconomic developments and consumer behaviour.

The *seasonal factors and* the *auction houses* are represented by the same way as in the previous section. The base seasonal dummy is the third quarter and the base auction house dummy is AUC14.

The *hedonic characteristics of the artwork* include dummy variables on whether: 1) it is signed, 2) it has a title, 3) its production year is known, 4) the medium it was made on (of), 5) the technique used, and 6) the genre of the work. In addition, the size of the work in cm^2 and the square of the size are included.

The *hedonic characteristics of the artists* are captured by dummy variables on whether the artist is: 1) alive or not, 2) Turkish or foreign origin, 3) the reputation of the Turkish artists, and 4) the known or estimated birthdate of the artists. In addition, we also represent artworks created by "anonymous" artists and those without sufficient information on the attributions of the artists by dummy variables. In view of the literature on the "death effects", we also consider two versions of such effects in our sample.

In our sample, about 43 per cent of the artists were alive at the time of the auction and more than 89 per cent of the artists are Turkish. The reputation of an artist is generally an important determinant of the price of an art object (Campos and Barbosa, 2009). In order to capture the reputation effects, we divided the Turkish artists into two categories: those who are considered to be among the "Top 500" artists and others. The selection of who is in the "Top 500" list was made according to the expert opinion in Ersoy (2004). According to Ersoy's classification, about 63 per cent of the works in our sample were created by those Top 500 Turkish artists.

In hedonic art market price index models, the usual approach is to denote each artist in the sample by a dummy variable. In our case, this approach would lead to hundreds of dummy variables and some of them would have only a few non-zero values. In view of this, we classified the artists with interaction dummies involving their birthdate, whether they are Turkish or foreigners, and the reputation of the Turkish artists. The birthdates were grouped into four time periods: 1) Born before 1900, 2) Born between 1900 and 1929, 3) Born between 1930 and 1959, and 4) Born after 1960. This approach led to 12 interaction dummy variables.

As part of the information on the artists, we also test for the *death effects*. The hypothesis for the presence or absence of death effects is whether the sales rates for the works made by artists who were deceased in the previous X-months or Y-years before the auction date are different than others. We test the death effects in two time frameworks. The first one is the immediate effect defined the 12-month period following the death of an artist. This is the case for 15 artists in our sample. The share of works under this variable constitutes about 1.43 per cent of the total works in the sample. The second death effect variable takes a 5-year horizon. This is the case for additional 17 artists and the share of works under this version of the death effect variable makes up about just less than five per cent of the total auction records in the sample. The list of all the variables in these categories and their representations in the sample as percentages are presented in Table 1.[12]

[12] The summary statistics on the hedonic characteristics of the artists are presented in the Appendix Table A1.

Table 1. Distribution of the Data in the Sample
(% of the Total for the Category)

BY SEASONAL DUMMIES	**%**		**BY THE MEDIUM OF THE ARTWORK**	**%**		**BY THE GENRE OF THE ARTWORK**	**%**
Q1	27.8		Canvas	49.55		Poster	0.05
Q2	27.3		Others	1.90		Landscape with figure	7.56
Q3	6.3		Paper	15.03		Abstract (Geometrical)	0.19
Q4	36.7		Wood	1.01		Gravure	0.19
			Carton	13.87		Sculpture	0.16
By Years	%		Cardboard	3.52		Cartoon	0.14
2005	20.6		Hardboard	0.29		Composition	4.80
2006	31.1		Duralite	7.82		Naive	0.05
2007	40.1		Pressed Canvas	1.19		Still life	7.80
2008 (Jan-Feb)	6.4		Plywood	2.60		Nude	2.76
						Orientalist painting	0.06
By Auction Houses	**%**		**By the Technique Used**	**%**		Pressing	0.42
Auction House 1	5.8		Oil	68.88		Self Portrait	0.22
Auction House 2	7.2		Serigraphy	0.77		Landscape	26.93
Auction House 3	27.4		Pressing	0.81		Portrait	4.51
Auction House 4	13.4		Figure (Design)	0.28		Ceramics	0.29
Auction House 5	1.3		Litography	0.36		Abstract	7.49
Auction House 6	2.0		Others	3.54		Abstract Figure	2.32
Auction House 7	11.4		Pencil	1.42		Abstract Composition	6.12
Auction House 8	7.1		Watercolour	7.25		Abstract Landscape	1.03
Auction House 9	1.7		Gouache	3.10		Abstract Portrait	0.27
Auction House 10	8.4		Ink pen	1.10		Unknown / Unclassified	6.86
Auction House 11	5.4		Acryll	3.22		Design	0.32
Auction House 12	1.1		Pastel	1.96		Other	0.12
Auction House 13	4.1		Mixed technique	7.92		Interior	0.86
Auction House 14	3.5		Collage	0.42		Figure	4.69
						Interior with figure	0.89
						Composition with figure	12.88

Note: The totals may not add up to 100 due to rounding.

There are hedonic-cum-microstructure models that relate an item's probability of being sold to its characteristics and the *auction house strategy*. The latter part includes the strategy of positioning the item in the auction. That is, the most valuable items may neither be the first nor the last items to be auctioned. The hypothesis is that the lot order matters. After all, an auction house's objective function is to maximise its sales revenue as the buyer's and seller's premiums are calculated according to the sales values. From this perspective, it is possible that auction houses may not concern themselves as much with general sales rates but rather with the sales rates for higher-valued items and/or more competition in bids for artworks in general. Still, an auction house should be concerned with its general sales rate. First of all, this is related to its reputation in the market. Secondly, there is evidence in the literature that unsold paintings (called as "bought-in" or "burnt") in an auction may lose value and affect the longer term proceeds for the auction houses.

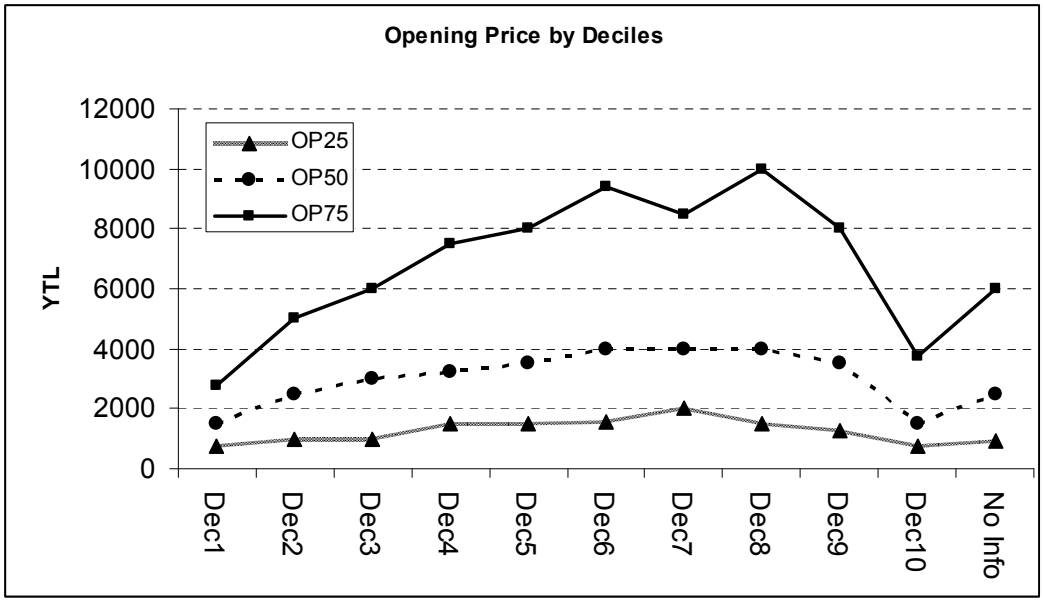
We find that the sales rates are the highest for the items positioned in the first two deciles of the total works in the auction. The sales rates decline thereafter until the middle of the auction, where it increases slightly, but lower sales rates follow afterwards. It is also interesting that the sales rate is the lowest in the last decile. More generally, there is a decline in the sales rate after the sixth decile. This suggests some evidence of an "afternoon effect" in the sales rates.

We do not have information on the expert estimates for the prices (or the expected price range) of the auctioned items in our dataset. Nevertheless, we do have the opening prices at the auctions for most of the artworks included in our study. The availability of the opening prices allows us to have a closer look at the auction house strategy and employ it as a determinant of the auction sales performance.

Figure 1 displays the first, the second, and the third quartile opening prices for the auctioned artworks by their relative auction position in terms of deciles.[13] The interpretation is as follows. The opening price at the first quartile for each decile by auction position shows the maximum starting price where the bottom 25 per cent of the auctioned works in that decile were priced. The second quartile corresponds to the median price. Given the wide range of prices and outliers observed in auctions, the median price should be a better indicator of the general price level in an auction than the arithmetic average. The third quartile price is the maximum starting price for the 75 per cent of the works auctioned. In other words, the opening price at the third quartile shows that 25 per cent of the auctioned artworks have opening prices above that price. As such, the price level at the third quartile can also act as an indicator of how expensive an auction is compared to other auctions.

[13] The distribution of the artworks by their position in the auction by deciles and their sales rates are presented in Appendix Table A2.

Figure 1. Opening Price by Deciles



A close look at Figure 1 shows that there is a general tendency for the opening prices to increase up to the sixth decile, i.e., the opening prices of the auctioned objects increase until 60 per cent of the works are auctioned. Thereafter, we see a decline which is especially sharp in the last 20 per cent of the auctions. In connection with the sales rates data presented in Table A2, it appears the auctioneers start by offering less expensive objects first for which they obtain the highest sales rates in the first 20 per cent of the auction, then continue with the more expensive items – albeit with lower sales rates. Then, they introduce less expensive items towards the end of the auction again – but with lower sales success. The decline in the sales rate after 60 per cent of the auction is completed despite the decline in the relative price level of the objects again points to an "afternoon" or "fatigue" effect, which is especially strong towards the end of the auctions. We include such microstructure effects and anomalies in our model.

The last set of variables in our model capture the *consumer confidence and business tendency* on general economic developments and investment decisions. The data were obtained from the Central Bank of the Republic of the Turkey (CBRT) online databases.[14] The variables employed include the changes in the expectations on consumer's consumption patterns, such as the outlook for consumer durables purchases in the current period, probability of purchasing a new car in the next 6 months, probability of purchasing or constructing a new

[14] http:\\www.tcmb.gov.tr

house within the next 12 months, and the probability of increased savings in the next 6 months. The inclusion of consumer confidence variables helps in capturing the economic mood in the auctions. Furthermore, the above variables also represent complementary or substitution effects to buying artworks, allowing us to gain insights about the consumers'/investors' portfolio choice problem that includes artworks. For instance, an increase in the probability of increased savings first means that less funds are available and secondly it shows whether buying artworks are perceived as an investment alternative. Similarly, if an increase in the probability of purchasing a new house in the next six months leads to lower sales rates of art objects, this may be interpreted as a substitution effect due to the competing use of available funds. On the other hand, a positive relationship might indicate that house purchases and artworks are complementary goods: e.g., those who buy new houses also may also have a tendency to buy artworks to decorate them.

5. Estimation Results

5.1 The Heckit – Modified Hedonic Price Model

The estimation results from the two-step Heckit model for our sample of sold and unsold artworks in Turkish art auctions are presented in Table 2 – Panel A.[15] The alternative estimates from the traditional hedonic price model are also presented in Table 2 – Panel B. The dependent variable is the log(sales price) in current Turkish liras. The number of observations is 6,771. Note that the models (except for the selection equation for the Heckit model) do not include a constant term since the full set of time-period dummies are employed.

The main results of the hedonic determinants of the Turkish art market prices within our Heckit model can be summarised as follows.

1) *The medium of the artwork*: Works made on plywood and on "other" materials sell for more than those made on wood. There is also a premium to "oil on canvas" works over works on wood, but no premium to canvas if the work is not made using oil. On the other hand, works made on paper and carton sell for a significantly less amount than works made on wood. This can be interpreted as a durability premium.

2) *Technique used*: Works made by using oil (even if it is not on canvas) and works involving gouache and mixed techniques sell for significanty more than the works made by various types of pencil works. Nevertheless, the artworks made by using serigraphy, pressing, watercolour, ink, and other techniques sell for lower prices than those made by pencil.

[15] Table 2 is placed at the end of the paper under "Estimation Results" due to its length.

3) *Genre effect*: The genre effect helps to capture the tastes. We find evidence that the genre of the artwork matters. For instance, the works depicting interiors, interiors with figure, landscape with figure, orientalist paintings, and sculptures are more likely to sell for a higher price than "still life". On the other hand, abstract landscape, ceramics, and cartoons sell for a lower price than still life motives.

4) *Other attributes of the artwork*: We have further evidence that the larger-sized works sell for higher prices but the negative coefficient of the square of the size variable indicates diminishing returns to the increases in the size of an art object. This is an established result in the literature. Furthermore, the works with a title and those whose production are known sell for more. However, we did not find an additional effect if the work is also signed by its artist.

5) *Auction position*: Our estimation results support the opening price-auction position relationship in the selling prices as well. The objects initially placed amongst the first 30 per cent of the total number of works to be auctioned have lower selling prices compared to those auctioned in the fifth decile. Then, the selling prices of the auctioned objects increase (compared to those in the fifth decile) until the eighth decile. The last 10 per cent of the objects to be auctioned have again lower selling prices. Note that this is also in line with the "afternoon effect" or the "fatigue effect" in the literature.

6) *Attributes of the Artist*: We find that prices of the works by the new generation of both Turkish and foreign artists born after 1960 have lower sales prices than the others. An exception is for the Turkish artists who were born after 1960 and who are considered to be among the top 500 have higher selling prices than the Turkish artists born after 1960 but who are not among the top 500. This indicates a "reputation effect" for the new generation artists. Among the other attributes of the artists, we find that the works by currently active (alive) artists (Turkish or foreign) have lower sales prices.

7) *Death effect*: Our estimates indicate that there is some death effect premium in the prices of the works by recently deceased artists. First, the prices of the works by artists who died in the previous 12 months of the auction date are found to be statistically higher but the effects reverses as more time (e.g., five years) passes.

8) *Consumer and business confidence*: We tried different consumer / business confidence and expectations on economic developments variables in our specifications and found that the expections for a better outlook for consumer durables and new car purchases are reflected as more optimistic mood in the art auction markets, leading to higher prices. On the other hand, when the mood is on the increased savings side, the art market prices also suffer from diminished confidence. Interestingly, we also find that when the probability of purchasing or

constructing a new house within the next 12 months increases, art markets suffer. This shows some substitution effect – making less funds available for art market purchases.

As discussed earlier, the key variable in a two-step Heckit model is the lambda parameter. In our case, the lambda has a negative sign (-0.2126) but it is not statistically significant at conventional levels.[16] This evidence indicates that there is not any sample selection for what is sold (or, symmetrically unsold). It could still be that all of the paintings could be drawn independently from the same distribution, or alternatively, all of the paintings are from independent distributions.[17] The implication is that the earlier hedonic price indices on the Turkish art market based only on sold paintings are unbiased.

The correlation coefficient between the error distributions of the sold and unsold works is -0.215. Again, it is not statistically significant, but the negative coefficient on the lambda estimate (along with the negative correlation coefficient) implies that the price index that would include the unsold works would lead to lower return estimates.

5.2 Interpreting the Results from the Heckit Sample Selection Equation

Table 2 also presents the estimates for the sample selection equation. Note that this part of the model might also provides insights into the determinants of sales success for the auctioned artworks since the explained variable in the selection is an artwork's probability of being sold in an auction. Yet, we present the results from this stage as a preliminary look into what inner dynamics of art auctions and discuss only some of the findings. Further research is needed to obtain a fuller picture.

The dataset covers 11,212 artworks auctioned during the January 2005 - February 2008 period. The dependent variable is SOLD, which takes the value of "1" if an item is recorded as sold and "0" otherwise. The mean of the dependent variable, that is the overall sales rate in the estimation sample, is 60.4 per cent.

An important empirical problem in two-step Heckit models is to determine what variables should be in the selection equation (probit model) and in the least-squares estimation (hedonic model). What is at stake is whether the final model is

[16] Collins et al. (2009) also use a Heckit model to test for the effects of a potential sample selection bias in art price indices. Their results do indicate a difference between the tradition hedonic index and the constructed from a Heckit model. While this should indicate a statistically significance lambda value, Collins et al. (2009) do not provide this information and instead conduct an F-test for the equality of the coefficients from the hedonic model versus the Heckit model estimates. Nevertheless, as our findings in Section 6 show, there might be differences between the price indices from the hedonic and the Heckit models, yet the lambda value is statistically insignificant.

[17] We thank an anonymous referee for suggesting these possibilities.

statistically identified or not. In the case where the selection equation and the second-step modified hedonic price model equation contain exactly the same variables, the final model is identified only if the errors terms are normally distributed. This is a strong assumption. Ideally, the identification should be obtained by including additional variables in the selection equation rather than using a subset of the second step model. (See Verbeek, 2008: 240 - 243 for a further discussion of the sample selection model and the problems associated with it.)

In our empirical set-up, the price determinants and the sales probabilities of auctioned artworks are related and they do overlap but they are not exactly the same. In particular, we employ the same set of explanatory variables for the hedonic price model described above; but, in order to make sure that the model is identified, we also include additional variables among the explanatory variables of the sample selection model such as the auction microstructure and further variables on consumer's expectations. The estimation results for the some specific groups of variables in our analysis are as follows.

1) *Nationality-Reputation-Birthdate interaction dummy variables*. For Turkish painters, the baseline dummy is taken as those with birthdates after 1960 and who are not listed in the top 500 Turkish artists. We find that the works by all of the top 500 (both older and newer generations) artists have higher sales rates than the baseline category. Nevertheless, for those who are not among the top 500 list, only the works made by those born between 1930 and 1960 have higher sales probability. For the artists with foreign origin, the baseline dummy is again those born after 1960. It is found that the works by those born before 1900 and those born between 1930 and 1960 have a higher probability of sales. Overall, these results show that there is a "master" effect. A similar effect might also be at work for the foreign artists.

2) *Death effects*. As disccussed earlier, we included two measures for the death effects. We estimate a higher probability of sales for the works of an artist who died within the 12 period prior to the auction. Nevertheless, when the period is extended to five years, the effect disappears. These findings indicate that the presence of a death effect in Turkish art auction sales rates is limited to the short-term.

3) *Sales order in the auction*. We tried to capture the microstructure of the auctions by assigning a dummy variable for the positioning of an item in the auction in deciles. The baseline dummy is taken as those auctioned in the fifth decile. The estimation results are in line with the sales rates per decile presented in Table 2. The art objects positioned at the beginning of the auction (the first 20 percent to be auctioned) have statistcally higher sales rates than those in the fifth decile. Furthermore, the last 10 per cent of the works to be auctioned have lower sales rates than those positioned in the fifth decile. Looking at these results in

view of the opening prices of the auctioned objects as shown in Figure 1, we can conclude that the cheaper items have higher sales probability at the beginning of the auction while this is not the case at the end of the auction. This finding can be seen as evidence of a "fatigue" or an "afternoon effect" in art auction sales rates in Turkey.

4) *Consumer and business confidence*. The expectations on improving economic conditions in the next three months, improvements in outlook for purchases of consumer durables and new cars, the rise of stock prices, the improvements in outlook, and a higher probability of buying a new house compared to 3 months ago are all found to increase the sales probability. Thus, we find a complementary relationship between consumer durables, cars, houses, and artworks. This is an important result. The possibility of such complemantarity effects is widely acknowledged but no quantitative support has been provided for this hypothesis so far.

6. Comparison of the Heckit-based Turkish Art Market Price Index with the Traditional Hedonic Price Model based on Sold Works Only

In order to construct the price indices, the coefficient estimates on the time-period dummies are used. The period-over-period changes in the price index can be calculated from $e^{(\beta t- \beta t-1)-1}$. Using the Heckit model estimates, the percentage change in the price index from 2005H2 to 2005H1 is $(e^{(5.42243-5.22516)-1})*100$, which is equal to about 23 per cent. Table 3 presents the estimated changes in the Turkish art auction market prices in semi-annual frequency.

Table 3. Comparison of the Results: Price Developments in The Turkish Art Market

	Coefficients			% change		Index	
Period	Hedonic	Heckit	Period	Hedonic	Heckit	Hedonic	Heckit
						100	100
2005H1	5.07975	5.22516	2005H1	14.75(*)	14.75(*)	114.75	114.75
2005H2	5.28676	5.42243	2005H2	22.9995	21.8073	141.14	139.77
2006H1	5.2475	5.34795	2006H1	-3.8499	-7.1774	135.71	129.74
2006H2	4.98422	5.07774	2006H2	-23.1473	-23.6781	104.30	99.02
2007H1	5.57242	5.73949	2007H1	80.0744	93.8181	187.81	191.92
2007H2	5.55379	5.72664	2007H2	-1.8458	-1.2768	184.34	189.47
2008 (Jan-Feb)	5.47374	5.45233	2008 (Jan-Feb)	-7.6930	-23.9904	170.16	144.02

(*) The figure is derived from Seçkin and Atukeren's (2009) calculations.

The overall picture in Table 3 is that the price changes or the returns in the Turkish art market were volatile on a semi-annual frequency between January 2005 and February 2008. Starting at 100 at the beginning of 2005, the hedonic price based on sold works only reached the level of 170.16 in February 2008, whereas according to the Heckit model, the level of the Turkish art market price index in February 2008 was 144.02. This is an expected result as the unsold items can be seen as having implied prices which did not reach the level of the reservation prices of the sellers. However, the difference should not be considered significant since the lambda coefficient in the Heckit model did not turn out to be statistically different than zero at conventional levels. Another way to analyse the returns is to look at them as annualised figures. They can be calculated by using the price index level data at each period and by converting them to annualised figures, which are shown in Table 4. For instance, the annualised return in 2007H1 is $((189.47/100)^{(1/5)})^2*100 = 29.79$ per cent per annum.

Table 4. Annualised Returns In The Turkish Art Auction Market (%)

Time Period	Traditional Hedonic Model (Sold Works Only)	Heckit Model (Sold and Unsold Works)
2005H1	31.68	31.68
2005H2	41.14	39.77
2006H1	22.58	18.96
2006H2	2.13	-0.49
2007H1	28.67	29.79
2007H2	22.61	23.74
2008(Jan-Feb)	16.40	10.98

Source: Own calculations based on the estimated coefficients from the Hedomic and Heckit models presented in Table 2.

Accordingly, Table 4 shows that, for the overall period from January 2005 to February 2008, the returns in the Turkish art auction market were about 16.4 per cent per annum according to the traditional hedonic price model while the returns were 10.98 per cent per annum according to the Heckit model. The consumer price inflation and the whole price inflation are 8.9 and 7.6 per cent per annum for the corresponding period. Hence, the art market in Turkey can be said to have served as a hedge against inflation during that period. This is in line with the previous finding on the Turkish art market (Seçkin and Atukeren, 2006, 2009). It should be also noted that the prices or the returns in the Turkish art market were also negatively affected by the world economic crisis from the second half of 2007 on.

7. Conclusions

This study examines the art auction performance in Turkey for the period between January 2005 and February 2008 using a unique database which contains 11,212 auctions records. Our analysis incorporates the unsold works into the analysis by means of the two-step Heckit model. The key variable in a two-step Heckit model is the lambda variable (i.e., the Inverse Mill's Ratio). Our estimation results yield a negative but statistically insignificant parameter estimate for the lambda variable in the Heckit model. Hence, we conclude that the exclusion of unsold paintings does not lead to biased estimates. Nevertheless, as the estimate of the lambda parameter is negative, the point estimates of the returns obtained under the Heckit model are lower. For instance, for the overall period from January 2005 to February 2008, the returns in the Turkish art auction market were about 16.4 per cent per annum according to the traditional hedonic price model while the returns were about 11 per cent per annum according to the Heckit model. The consumer price inflation and the whole price inflation are 8.9 and 7.6 per cent per annum for the corresponding period. In both cases, the art market in Turkey can be said to have served as an inflation hedge during that period.

Our model also allows us to test for a number of behavioral aspects in art auctions. For instance, we indeed find that the art objects positioned at the beginning of the auction (the first 20 percent to be auctioned) have statistically higher sales rates than those in the fifth decile. Furthermore, the last 10 per cent of the works to be auctioned have lower sales rates than those positioned in the fifth decile. Hence, we can conclude that the cheaper items have higher sales probability at the beginning of the auction while this is not the case towards the end of the auction. This finding can be seen as evidence of a fatigue or an afternoon effect in art auction sales rates in Turkey. A similar effect is also found in sales prices.

Regarding the characterictics of the artists, our results demonstrate a reputation effect in sales rates for the Turkish artists who are considered to be among the top 500 according to expert opinion. We have found evidence for death effects in both sales rates and in art prices. Nevertheless, the presence of a death effect in Turkish art auction sales rates is limited to the short-term. Regarding the death effect in art market prices, we again find that that there is some death effect premium in the prices of the works by artists who passed away in the previous 12 months of the auction date.

Furthermore, using business and consumer survey data to capture the role of macroeconomic developments and expectations and consumers' choice-theoretic decisions in explaining art market buying behaviour, we find that the expectations for a better outlook for consumer durables and new car purchases also reflect themselves as stronger mood in the art auction markets, leading to

higher prices. On the other hand, when the mood is on the increased savings side, the art market prices also suffer from diminished confidence. In the case of the relationship between stock market performance and prices in the art markets, the literature documents a linkage through wealth effects. Our study also establishes the wealth effects link in the form of higher auction sales rates as well. Our estimation results also indicate that an increase in the probability of increased savings leads to a decline in art market sales rates. This result is in line with the expectations that people defer their purchases of superior goods in times of economic restraint.

ESTIMATION RESULTS

Table 2. Two-Step Heckit Model versus the Traditional Hedonic Price Model Estimates

Two-step Heckit estimates using 6771 observations
Dependent variable: log(Sale Price)
Heteroskedasticity-robust standard errors

	Panel A			**Panel B**		
	Heckit Model			**Traditional Hedonic Price Model**		
	Coefficient	***z-score***	**Sig.**	***Coefficient***	***z-score***	**Sig.**
Semi-Annual Time Dummies						
2005H1	5.22516	14.71	***	5.07975	30.03	***
2005H2	5.42243	15.17	***	5.28676	32.52	***
2006H1	5.34795	16.59	***	5.2475	33.69	***
2006H2	5.07774	14.25	***	4.98422	30.03	***
2007H1	5.73949	15.94	***	5.57242	35.43	***
2007H2	5.72664	16.6	***	5.55379	34.56	***
2008(Jan.-Feb.)	5.45233	17.05	***	5.47374	24.67	***
Auction Houses (Base category Auction house 14)						
Auction House 1	1.7614	10.87	***	1.80856	17.06	***
Auction House 2	1.07069	6.467	***	1.07664	10.88	***
Auction House 3	0.900473	5.771	***	0.899128	9.846	***
Auction House 4	1.92444	9.509	***	1.92073	20.14	***
Auction House 5	1.4232	7.506	***	1.31666	9.792	***
Auction House 6	0.946371	5.394	***	0.83949	6.859	***
Auction House 7	1.30156	8.214	***	1.25394	13.38	***
Auction House 8	1.32438	6.964	***	1.40055	15.2	***
Auction House 9	-0.574753	-2.937	***	-0.813837	-4.949	***
Auction House 10	1.35027	7.879	***	1.29466	13.42	***

Auction House 11	0.998188	6.4	***	0.975434	10.01	***
Auction House 12	0.529036	2.606	***	0.490324	2.889	***
Auction House 13	1.03734	6.103	***	1.01465	9.623	***
Medium of the Artwork (Base category = Wood)						
Paper	-0.325696	-4.28	***	-0.407867	-5.744	***
Carton	-0.243664	-3.045	***	-0.293902	-3.798	***
Cardboard	-0.0797981	-0.8098		-0.158769	-1.599	
Hardboard	0.224747	0.9728		0.23027	1.035	
Duralite	-0.116447	-1.303		-0.191824	-2.264	**
Pressed Canvas	0.0456445	0.3297		-0.0128627	-0.1004	
Plywood	0.181489	1.704	*	0.0495575	0.4734	
Other materials	0.316593	2.592	***	0.240563	1.872	*
Canvas (Oil technique)	0.418734	4.267	***	0.340909	3.65	***
Canvas (Not Oil technique)	-0.010197	-0.08771		-0.15085	-1.462	
Technique Used (Base category = Pencil)						
Oil not on Canvas	0.251644	3.13	***	0.286949	3.89	***
Watercolor	-0.236926	-2.912	***	-0.17444	-2.361	**
Gouache	0.567001	6.384	***	0.650844	7.33	***
Ink	-0.256957	-1.897	*	-0.169114	-1.684	*
Acyrll	-0.0373156	-0.3118		0.0228337	0.2188	
Pastel	-0.0607289	-0.5306		-0.0717074	-0.6532	
Mixed Technique	0.185343	2.448	**	0.217969	3.234	***
Collage	0.180462	1.083		0.34484	2.181	**
Serigraphy	-0.786295	-4.335	***	-0.787713	-4.583	***
Pressing	-0.75483	-3.878	***	-0.844631	-5.531	***
Design	-0.04508	-0.1581		-0.0268934	-0.1335	
Litography	0.118738	0.5212		0.244257	1.172	
Other	-0.206381	-1.888	*	-0.0627712	-0.6206	
Genre of the Artwork (Base cateory = Still Life)						
Poster	0.550163	0.7743		0.432889	1.316	
Print	-0.457411	-2.007	**	-0.466067	-2.432	**
Unknown	0.521252	1.63		0.212712	1.702	*
Design	-0.687491	-2.639	***	-0.703614	-3.857	***
Other	0.234032	0.4652		-0.0522141	-0.05864	
Interior	0.372075	2.916	***	0.35976	2.246	**
Figure	-0.0284129	-0.4129		-0.0658655	-1.012	
Interior with Figure	0.512991	4.013	***	0.579265	4.176	***
Composition with Figure	0.172541	3.099	***	0.147278	2.854	***
Landscape with Figure	0.252238	4.129	***	0.205191	3.698	***
Geometrical Abstract	0.237532	0.8159		0.16571	0.7515	

Gravure	0.543777	1.071		0.48937	0.5025	
Sculpture	0.850337	2.996	***	0.811218	4.179	***
Cartoon	-0.484865	-1.66	*	-0.0349357	-0.2016	
Composition	-0.0284496	-0.4109		-0.0418224	-0.6611	
Naïve	0.202911	0.289		0.0149988	0.01646	
Nude	0.0099263	0.1191		0.0358119	0.505	
Orientalist Painting	1.18852	1.692	*	1.42997	1.433	
Self-Portrait	0.158727	0.6131		0.0879753	0.3054	
Landscape	0.0352218	0.707		0.0282346	0.5958	
Portrait	0.0510153	0.6981		0.0235755	0.3264	
Ceramics	-8.22E-01	-3.671	***	-0.608102	-3.295	***
Abstract	-8.58E-02	-1.337		-0.125675	-2.063	**
Abstract Figure	3.88E-02	0.4095		0.0782746	0.9379	
Abstract Composition	0.0319816	0.4567		0.0258041	0.4169	
Abstract Landscape	-0.339443	-2.497	**	-0.300248	-2.132	**
Abstract Portrait	0.0204336	0.08842		0.0926026	0.4683	
Other Atrributes of the Artwork						
Size (cm2)	8.64E-05	19.08	***	0.00011659	21.38	***
Size-squared	-1.06E-09	-10.46	***	-2.29E-09	-13.4	***
Production year known = 1	0.120743	4.33	***	0.0675612	2.683	***
Sıgned = 1	0.0356594	0.6081		0.0661523	1.278	
Titled = 1	0.22405	7.426	***	0.236256	9.149	***
Position in the Auction						
Decile 1	-0.621191	-10.92	***	-0.564382	-12.35	***
Decile 2	-0.281362	-5.15	***	-0.253291	-5.718	***
Decile 3	-0.186645	-3.382	***	-0.225176	-4.566	***
Decile 4	0.0436247	0.7811		0.0494079	1.009	
Decile 6	0.107403	1.918	*	0.0868463	1.606	
Decile 7	0.124665	2.221	**	0.124585	2.328	**
Decile 8	0.185452	3.371	***	0.172825	3.279	***
Decile 9	-0.0462875	-0.8525		-0.0100043	-0.1906	
Decile 10	-0.315106	-5.243	***	-0.330102	-6.476	***
Artist: Turkish / Foreign, Reputation, Birthdate period						
Top500 Turkish artist, Born before 1900	1.73282	18.31	***	1.69822	21.67	***
Top500 Turkish artist, Born between 1900-1929	1.28617	14.86	***	1.28667	19.2	***
Top500 Turkish artist, Born between 1930-1959	0.851637	10.61	***	0.873242	14.09	***
Top500 Turkish artist, Born after 1960	0.163884	1.29		0.210795	2.78	***
Non-Top500 Turkish artist, Born before 1900	1.22829	12.15	***	1.18653	12.94	***

Non-Top500 Turkish artist, Born between 1900-1929	0.562831	5.582	***	0.601641	7.652	***
Non-Top500 Turkish artist, Born between 1930-1959	0.453057	5.272	***	0.471073	6.67	***
Foreign artist born before 1900	1.40576	14.25	***	1.33954	15.17	***
Foreign artist born between 1900-1929	0.507299	2.837	***	0.397676	2.517	**
Foreign artist born between 1930-1959	0.931466	6.336	***	1.04082	7.944	***
Other Atrributes of the Artist						
ALIVE = 1	-0.514906	-12.81	***	-0.478656	-14.2	***
Insufficient artist info	0.432104	1.46		0.185232	0.4779	
Unknown birthdate period	-0.0808769	-0.2845		-0.119053	-0.3793	
Death Effect						
Artist died within the previous 12 months of the the Auction date	0.24706	2.118	**	0.441692	3.754	***
Artist died within the past 5 years of the Auction date	-0.308922	-4.414	***	-0.368529	-5.013	***
Economic Expectations						
Outlook for Consumer Durables purchases in the current period, 3 Mo. % change	0.0284498	4.7	***	0.0303887	5.603	***
Probability of purchasing a new car in the next 6 months, 3 mo. % change	0.0791432	2.593	***	0.0624836	2.3	**
Probability of purchasing or constructing a new house within the next 12 months, YoY % change	-0.118557	-4.681	***	-0.116012	-4.943	***
Probability of increased savings in the next 6 months, 3 mo. % change	-0.0438644	-4.695	***	-0.041532	-5.114	***
Inverse Mills Ratio						
Lambda	-0.212575	-1.192				

Selection Equation for the Heckit Model

	Coefficient	***z-score***	***Significance level***
Constant	-1.55217	-7.489	***
Auction Houses (Base category Auction house 14)			
Auction House 1	0.609685	3.324	***
Auction House 2	0.58344	3.278	***

Auction House 3	0.574543	3.329	***
Auction House 4	1.44035	8.35	***
Auction House 5	0.975547	5.024	***
Auction House 6	0.184246	0.9012	
Auction House 7	0.535154	3.041	***
Auction House 8	1.10267	6.16	***
Auction House 9	0.355155	1.773	*
Auction House 10	0.674975	3.733	***
Auction House 11	0.561129	3.168	***
Auction House 12	0.118345	0.5683	
Auction House 13	0.777607	4.58	***
Seasonal Dummies			
Q1	0.425168	4.646	***
Q2	0.205491	2.574	**
Q4	0.0297268	0.3848	
Medium of the Artwork			
Paper	0.146389	1.783	*
Carton	0.154489	1.846	*
Cardboard	0.117164	1.101	
Hardboard	0.287563	1.152	
Duralite	0.238389	2.561	**
Pressed Canvas	0.342251	2.426	**
Plywood	0.195334	1.748	*
Other materials	0.145852	1.137	
Canvas (Oil technique)	0.224609	2.324	**
Canvas (Not oil technique)	0.495928	4.155	***
Technique Used			
Oil not on Canvas	-0.0197909	-0.2501	
Watecolor	0.126184	1.567	
Gouache	0.120842	1.317	
Ink	0.0023812	0.01806	
Acyrll	-0.386592	-3.296	***
Pastel	0.0993981	0.8425	
Mixed Technique	0.0473068	0.6378	
Collage	0.266836	1.386	
Serigraphy	-0.113897	-0.7052	
Pressing	0.288131	1.596	
Design	-0.299084	-1.231	
Litography	0.414978	1.863	*
Other	0.200116	1.838	*

Genre of the Artwork			
Poster	-0.568959	-1.036	
Print	-0.380344	-1.887	*
Unknown	-1.95557	-21.38	***
Design	-0.428151	-1.949	*
Other	-0.436328	-0.9493	
Interior	0.0189635	0.1317	
Figure	0.0419707	0.5499	
Interior with Figure	0.381608	2.369	**
Composition with Figure	0.0516633	0.8415	
Landscape with Figure	0.037966	0.5557	
Geometrical Abstract	-0.415398	-1.546	
Gravure	-0.716288	-1.95	*
Sculpture	0.445628	1.103	
Cartoon	0.668909	1.693	*
Composition	0.0392691	0.5221	
Naïve	-1.07863	-2.003	**
Nude	-0.00384961	-0.04355	
Orientalist Painting	0.525695	0.8344	
Self-Portrait	0.101591	0.3669	
Landscape	-0.0794392	-1.493	
Portrait	-0.10171	-1.334	
Ceramics	7.02E-01	2.515	**
Abstract	-5.40E-02	-0.7883	
Abstract Figure	-1.68E-01	-1.743	*
Abstract Composition	3.12E-02	0.4115	
Abstract Landscape	-0.257012	-1.93	*
Abstract Portrait	0.561772	2.126	**
Other Atrributes of the Artwork			
Size (cm2)	6.26E-06	1.287	
Size-squared	-1.09E-10	-1.027	
Production year known = 1	0.0395518	1.345	
Signed = 1	0.238747	4.395	***
Titled = 1	0.121735	3.999	***
Position in the Auction			
Decile 1	0.18642	3.129	***
Decile 2	0.157668	2.694	***
Decile 3	0.0629222	1.064	
Decile 4	0.0701778	1.173	
Decile 6	-0.00808197	-0.1339	

Decile 7	0.00037622	0.006204	
Decile 8	-0.0442985	-0.754	
Decile 9	-0.046533	-0.8073	
Decile 10	-0.238154	-4.112	***
Artist: Turkish / Foreign, Reputation, Birthdate Period			
Top500 Turkish artist, Born before 1900	0.318128	3.432	***
Top500 Turkish artist, Born between 1900-1929	0.312474	3.782	***
Top500 Turkish artist, Born between 1930-1959	0.249758	3.278	***
Top500 Turkish artist, Born after 1960	0.29418	2.258	**
Non-Top500 Turkish artist, Born before 1900	0.0432679	0.4256	
Non-Top500 Turkish artist, Born between 1900-1929	0.122686	1.23	
Non-Top500 Turkish artist, Born between 1930-1959	0.186914	2.213	**
Foreign artist born before 1900	0.253578	2.566	**
Foreign artist born between 1900-1929	-0.109786	-0.6692	
Foreign artist born between 1930-1959	0.346969	2.179	**
Other Attributes of the Artist			
ALIVE = 1	0.138561	3.283	***
Unknown birthdate period	-0.124081	-0.4188	
Insufficient artist info	0.10262	0.3344	
Death Effect			
Artist died within the previous 12 months of the the Auction date	0.378547	2.842	***
Artist died within the past 5 years of the Auction date	-0.0334493	-0.4775	
Economic Expectations – Survey Data			
General Economic Outlook for the current period compared to the previous 3 months, 3 mo. % change	-0.107535	-4.987	***
General Economic Outlook for the next 3 months, 3 mo. % change	0.0920839	4.068	***
Outlook for Consumer Durables purchases in	0.0595645	7.718	***

the current period, 3 Mo. % change			
Probability of purchasing a a new car within the next 6 months, YoY % change	0.0255189	2.939	***
Probability of purchasing a a new car within the next 6 months, 3 mo. % change	0.161742	5.392	***
Probability of purchasing or constructing a new house within the next 12 months, 3 mo. % change	0.14727	6.999	***
Probability of purchasing or constructing a new house within the next 12 months, YoY % change	-0.188993	-6.741	***
Probability of increased saving in the next six months, YoY % change	-0.039679	-5.089	***
Outlook for changes in the price level in the next 12 months, YoY % change over the current period	-0.00975019	-3.518	***
Outlook for changes in the price level in the next 12 months, 3 mo. % change over the current period	-0.0123903	-2.163	**

Regression Statistics:

Heckit Model	**Traditional Hedonic Price Model**
Total observations: 11212	$R^2 = 0.528944$
Censored observations: 4441 (39.6%)	Adjusted $R^2 = 0.521737$
sigma = 0.986662, rho = -0.215449	F-statistic (101, 6669) = 72.68258***
	Log-likelihood = -13866.80

APPENDIX

Table A1. The Distribution of the Data on the Artists in the Sample (% of the total for the category)

Variables	%	
ALIVE: Alive = 1, Deceased = 0	43.31	
TURKISH: Turkish = 1, Foreign = 0	89.05	
Top 500 (T500) Turkish Artist = 1	62.96	
Not sufficient artist info or Anonymous (NOINFO)	8.04	
Unknown Birthdate	7.43	
	%	**Full-Sample**
Death Effect Dummy 1 (DE1): Artist died within the 12-month period before the auction date	1.43	Turgut Atalay, Zahir Güvenli, Jülide Aılmaz, Gürdal Duyar, Nuri İyem, Şeref Bigalı, Ferit Apa, Mehmet Uygun, Kristin Saleri, Hasan Kavruk, Hamza İnanç, Mümtaz Yener, Asım İşler, Atilla Bayraktar, Fahir Aksoy
Death Effect Dummy 2 (DE2): Artist died within the 5-year period before the auction date	4.97	Artists included in DE1 and: Abdullah Taktak, Asuilty Guyor, Avni Arbaş, Cahit Derman, İsmail Altınok, Lütfü Cülcül, Mustafa Turgut Tokad, Nazmi Yılmaz, Neşet Günal, Nihat Akyunak, Rafet Ekiz, Setrak Mıskçiyan, Simon Samsonian, Sirun Adın, Şükriye Dikmen, Theodore Weber, Timos
	%	**Some Examples**
Top 500 Turkish artist, Born before 1900	10.98	Hoca Ali Rıza, İbrahim Çallı, Sami Yetik, Osman Hamdi Bey, Eşref Üren
Top 500 Turkish artist, Born between 1900 and 1929	27.25	Nuri İyem, Mübin Orhon, Fahrelnisa Zeid, Fikret Mualla, Avni Arbaş, Fikret Mualla
Top 500 Turkish artist, Born between 1930 and 1959	23.41	Komet, Necdet Kalay, Serap Demirağ, Utku Varlık, Yusuf Taktak, Devrim Erbil
Top 500 Turkish artist, Born after 1960	1.31	Arzu Başaran, Mustafa Özel, Onay Akbaş, Gürhan Yücel, Bahar Kocaman
Non-T500 Turkish artist, Born before 1900	5.26	Nazmi Ziya, Diyarbakırlı Tahsin, Yüzbaşı Hidayet, Şerif Renkgörür, Üsküdarlı Mahmut
Non-T500 Turkish artist, Born between 1900 and 1929	4.46	Celal Uzel, Türkan Kıran, Nihat Akyunak, Hulusi Mercan, Afife

		Ecevit
Non-T500 Turkish artist, Born between 1930 and 1959	8.95	Hüseyin Cahit Derman, Ayhan Türker, Canan Tolon, Ali Demir, Hüseyin Cahit Derman
Non-T500 Turkish artist, Born after 1960	4.16	Nuri Yakupoğlu, Sevinç Altan, Deniz Orkuş, Ebru Uygun, İsmail Ateş
Foreign artist, Born before 1900	6.98	Karl Karlovich Zommer, Fausto Zonaro, Albert Mille, Pablo Picasso, Amadeo Preziosi, Leonardo de Mango
Foreign artist, Born between 1900 and 1929	1.27	Alberto Giacometti, Thedore Weber, Kristin Saleri, Kazimierz Rubolowski, Salvador Dali
Foreign artist, Born between 1930 and 1959	1.13	Nikolai Saraphanov, Giovanna Barozzi, Jean Bastista Delarue, Kuzim Sergei, Louis Michel Hadengue
Foreign artist, Born after 1960	0.21	Mark Kostabi, Zümrüt Y. Radau, Guido Casaretto, Sergio Saez, Eduard Grützner

Note: The totals may not add up to 100 due to rounding.

Table A2. Positioning of the Works in the Auction and the Sales Ratios

	Position in % brackets	No. of Sold Works	Total No .of Works	Sales Ratio
Decile 1	0 =< X < 10	824	1288	0.6398
Decile 2	10 =< X < 20	873	1338	0.6525
Decile 3	20 =< X < 30	725	1216	0.5962
Decile 4	30 =< X < 30	713	1236	0.5769
Decile 5	40 =< X < 40	706	1194	0.5913
Decile 6	50 =< X < 60	690	1145	0.6026
Decile 7	60 =< X < 70	669	1143	0.5853
Decile 8	70 =< X < 80	721	1260	0.5722
Decile 9	80 =< X < 90	813	1426	0.5701
Decile 10	90 =< X =< 100	801	1621	0.4941
No information		39	87	0.4483

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